

SCIENCE

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FRIDAY, JUNE 3, 1898.

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MMS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ON A FLICKER PHOTOMETER.

IN the September number of the *American Journal of Science* for 1893 I described a photometric method founded on flickers which I had proved to be independent of color, and stated that there did not seem to be any reason why it should not be applied to ordinary photometric work. In January, 1896, Professor F. P. Whitman published, in the *Physical Review*, an account of a photometer with a revolving disc of cardboard, in which this flicker method was utilized with more or less success. Afterwards I constructed and experimented with five different forms of flicker photometers, and in November, 1896, read a paper on the subject before the National Academy of Sciences.

I propose here to give a short account of one of these forms, and to mention a few experiments that were made with it by myself and others.

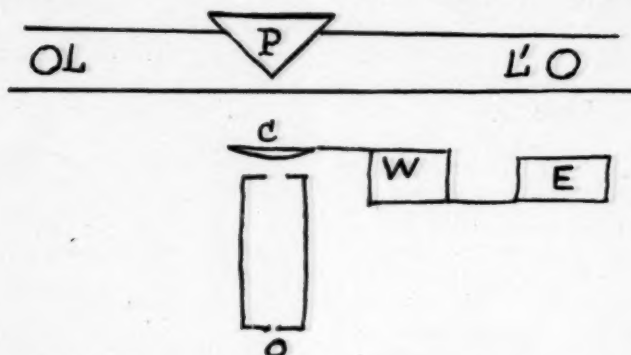
The two sides of the white, upright, 90° prism, P, are illuminated with the lights to be compared, coming from the incandescent lamps L and L', and the flicker is brought about by the rapid motion of the cylindrical lens, or biprism of small angle, C. This is caused to oscillate horizontally by a train of toothed wheels, W, which can either be turned by hand, or better by a small electromotor, E, the speed of which is regulated by a friction break. When the apparatus is in action the two illuminated sides

of the prism, P, are presented rapidly in succession to the eye placed at the aperture, O. The incandescent lamps, L, L', move over graduated bars or 'ways,' the total length of which is 3.3 meters. A long light wooden rod with a square cross-section is employed to move one of the lamps, and to carry the file of paper on which the readings are registered, obviating the necessity of removing the eye from O.

lamps was determined by Dr. Tufts and myself on the same day, the results in each case being the mean of 15 readings.

Dr. Tufts	O. N. R.
90.79	90.94
91.49	
91.14	

The difference between Dr. Tuft's mean and my result being $\frac{1}{10}$ of a per cent.



It is important that the edge of the prism where its faces meet should be *sharp*, and a satisfactory prism of this kind I have made from plaster of Paris cast in a peculiar mould, but unglazed paper stretched over a well-made wooden prism answers tolerably well, when prepared with a preliminary vertical cut extending not quite half way through the paper. In all the determinations given below, this arrangement was used, although it is certain that a prism with an *invisible* edge would have furnished still better results. The electromotor was usually employed; always when persons other than myself used the apparatus.

In order to show the action of the photometer with white light some experiments by myself in company with other persons are given below. The relative illuminating power of two 16-candle power incandescent

Three weeks later I made experiments, still using white light, with ladies, who saw the photometer for the first time. The figures obtained were:

Miss L.	Miss H.	O. N. R.
92.47	91.31	91.33

To test the action of the photometer with saturated colored light, the amount of light transmitted by a plate of red glass was directly determined, the result being that out of 100 rays of white light it transmitted 14.6. In this case the flicker was, of course, between almost spectral red and white light. A similar determination was made with a plate of green glass; it transmitted 8.4 rays. Here the flicker was between almost spectral green light and white.

These two plates of glass were then placed on opposite sides of the prism and the ratio of the amounts of light transmitted by them determined. In this case the flicker

was between spectral red and green. In the calculation of the results the amount of red light transmitted was taken as 14.6, and the amounts of green light calculated from the ratios obtained; these were as follows:

8.7 The mean of all the results was
 8.9 8.78, instead of 8.4 per cent, as di-
 8.7 rectly determined.
 8.9 These measurements were made
 9.4 by myself, but I thought it would be
 8.6 interesting to see how nearly the
 8.3 same result would be obtained by a
 8.78 person wholly unused to the photometer, and in general to photometric work. Miss L., after the nature of a flicker had been explained to her, at once obtained 9.07, which differs by $\frac{8}{100}$ of a per cent. from the mean of my more elaborate work.

Results of equal or greater accuracy were obtained by myself and others using blue and red light, or green and blue light, all of them being intense or saturated. No trouble was found in causing the disappearance of the flicker when the speed of the motor was properly regulated, nor were the eyes more fatigued than in making ordinary optical observations; of course, if the illumination is feeble the flicker becomes feeble; consequently the lamps and their distances from the prism should be so chosen as to afford the best illumination possible under the given conditions.

OGDEN N. ROOD.

COLUMBIA UNIVERSITY.

THE NEW YORK ZOOLOGICAL PARK.

MUCH progress has been made during the past year by the Zoological Society of New York, and the establishment of the Park in the near future now depends solely upon the cooperation of the city government. Under the present city administration, and especially with the policy of economy which has been generally adopted, it appears possible that the project may be somewhat de-

layed, although the Park Commissioners are in hearty sympathy with the project of the Society.

In the recently issued report of the Executive Committee, the following are enumerated as the chief results of the year's work: A contract with the City of New York, unanimously adopted by the Commissioners of the Sinking Fund, March 24, 1897; completion of the General Plan of the Park, and its unanimous approval by the Park Commissioners, November 22, 1897; subscription of the first \$100,000 toward the gift of \$250,000 from the Society to the city, completed February 15, 1898; preliminary plans of nine of the principal buildings, prepared and submitted for criticism to several American and European zoological garden specialists; increase of the membership of the Society from 118 to 600 active members.

According to the agreement with the city, \$125,000 is to be expended by the city in the preparation of walks, sewers, public comfort buildings, boundary fences, etc., and a large part at least of this preliminary work is absolutely essential before the Society can judiciously expend any portion of its Park Improvement Fund of \$250,000. During the next few weeks the matter will probably be decided, and in the meantime detailed plans for every division of work are being prepared with the greatest care.

The preliminary plan of the Park presented by Director Hornaday in 1896 was used as a basis for criticism and suggestion by various leading zoological experts of the country, especially by Dr. C. Hart Merriam, Mr. George B. Grinnell and Mr. D. G. Elliott, who made a careful inspection of the Park and offered a number of valuable suggestions. The preliminary plan was then approved by the Executive Committee and a close topographical survey of the Park ordered. The next step was the combination of the zoological or scientific with the



SKETCH MAP OF NEW YORK CITY.

Showing the Location of the proposed Zoological Park, and present Means of Access.

landscape and architectural features; and an able committee of experts consented to serve, as follows: Mr. Thomas Hastings, of Carrere & Hastings (architects of the new public library); on engineering, Mr. W. Barclay Parsons (of the Rapid Transit Commission); and upon the general landscape development, the late Park Commissioner, William A. Stiles. Professor Chas. S. Sargent, of Harvard University, also accepted a place on this Advisory Committee, but was subsequently prevented from serving. Messrs. Heins & La Farge were appointed architects, and began to develop the details of the plans, in constant consultation with the Director. Upon the general plans of the buildings for animals, Mr. Arthur E. Brown, Superintendent of the Zoological Garden at Philadelphia; Mr. Carl Hagenbeck, of Hamburg; Dr. J. A. Allen, of the American Museum of Natural History, among others were consulted, and kindly gave their valuable time and advice. After several months of labor a final plan of the Zoological Park was completed, and on November 15th was formally approved by the Park Commissioners. The following memorandum accompanied the plan:

The fundamental principles which the Zoological Society has observed in discharging its duty toward the City of New York and the general public in the planning and the development of the Zoological Park, may be briefly formulated as follows:

1. The Zoological Park must be established on lines by which it can be made a complete success zoologically, and also satisfactory and beneficial to the public.

2. The very valuable tract of park land, consisting of 261 acres, assigned to the Society's use as a site, must not be injured in any way, either permanently or temporarily, but must at all times be regarded as a trust.

3. Even of the area devoted to animal collections, the choice landscapes are to be

preserved unharmed, by locating all the large closed buildings so that they will be unobtrusive, especially from the boundary boulevards.

4. In selecting suitable locations for the numerous collections of creatures that will be required to live in the open air all the year round, it is of paramount importance that such animals should have all the advantages that are available in the nature of shade, shelter from westerly winds, dry situations, etc., in order that they may survive as long as possible.

5. So far as it be possible, it is extremely desirable that all animals living in the open air should be so installed that their surroundings will suggest, even if not closely resemble, their natural haunts.

6. The fences for large animals in open ranges shall be of the lightest description consistent with the proper confinement of the animals, and all posts used shall be as unobtrusive as possible.

7. As far as possible, the general aspect of wildness which now characterizes South Bronx Park must be maintained. In other words, it is desirable that the Park should be maintained as a well-kept and accessible natural wilderness rather than as a conventional city park.

8. It is totally inexpedient and undesirable to have the area of the animals bisected in either direction by a carriage roadway, other than that projected to lead to the principal restaurant.

9. A single-track road for horseless carriages, so laid out as to reach the principal buildings and collections, but without interfering with pedestrians, is not objectionable, and will probably become necessary.

10. In order to protect and control the Zoological Park, the area for the animals, west of the Boston road, must be entirely surrounded by a light wire fence, save on the north side, where the water forms a natural barrier.



THE UPPER END OF BRONX LAKE, NEW YORK ZOOLOGICAL PARK.

The 261 acres assigned to the Park is an especially beautiful and diversified area, combining open glades with thickets, heavy forest, natural streams and waterfalls, long areas of rocky cliffs, and traversed by the beautiful waters of the Bronx. It seems to the visitor hardly credible that such an area should have been preserved so close to a large city. It is evident that it should be developed with the very greatest care, and it is believed that the final plan of the Zoological Park will preserve all the natural beauty of this tract, and greatly enhance its interest to the people of the City and State of New York.

In regard to the zoological arrangement and the development of the plans of the buildings, the Director reports as follows:

"Our final plan is believed to locate each species as nearly as possible where nature would design to have it placed; to absolutely avoid all disfigurement of the site; to make the most of the shade which nature has provided; to enable the visitor to see the whole series of collections with the least possible amount of walking; to yield the greatest return for the money that is to be expended, and last, but not least, to yield something that is hardly to be found to an equal degree in any smaller zoological garden or park—a logical and fairly symmetrical zoological arrangement.

"In the preparation of the plans for the buildings to be erected in the Zoological Park, the Director was required to furnish to the architects a series of preliminary ground plans, and the details of such other scientific features as cage arrangement and general assignment of space. In this connection it is a pleasure to acknowledge the assistance that has been derived from certain European zoological gardens, whose buildings have furnished points that have been incorporated in our own.

"The plan of our Lion House contains several ideas drawn from the admirable

London Lion House, but with one noteworthy improvement, by means of which the out-door and in-door cages are provided with free communication. The plan of our Elephant House contains features derived from the well-nigh perfect 'Palais des Hippopotames' in Antwerp. Our Antelope House contains many ideas borrowed from that in Frankfort. Our Reptile House copies several features from that in the London Garden, but many of its most important features are original.

"Our Bird House, Monkey House, Subtropical House, Small Mammals' House, Winter House for Birds, Administration Building, Bear Dens, Wolf and Fox Dens, Alligators' Pools, Burrowing Rodents' Quarters, Squirrel Installations, Beaver Pond and Aquatic Rodents' Ponds all are features absolutely new, both in design and general arrangement."

The plans of nine of the principal buildings have now been drawn with great care, but, with the exception of the Monkey House and Reptile House, they are still in the formative stage of development.

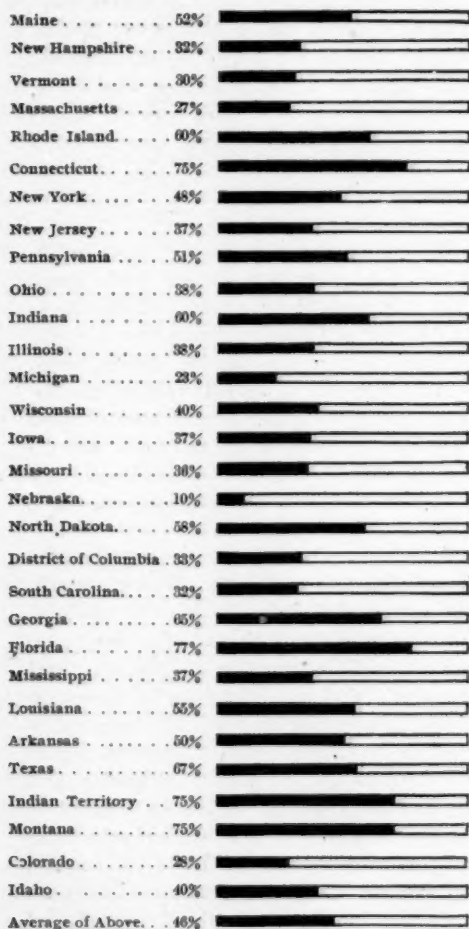
Although the principal work of the Society during the past year has been devoted to securing a firm financial basis, and to the development of a thoroughly satisfactory plan, some of the other objects have been considerably furthered.

It is our purpose to make especial provisions and facilities for artists and sculptors in the various buildings, in order to establish a school of animal painting and sculpture which shall be worthy of this city and country. As an object lesson for American cities, Director Hornaday has prepared a very careful and fully illustrated report upon "The London Zoological Society and its Gardens," which will be of interest to keepers and patrons of zoological gardens in all parts of this country. He has also made, by means of postal correspondence, an extended inquiry as to the destruction of

birds and mammals in different parts of the United States. While results obtained in this way express opinions rather than exact statistics, the column showing the percentages of decrease in bird life during the last fifteen years will be of value in arousing the national sentiment for the preservation of

DECREASE IN BIRD LIFE IN THIRTY STATES.

The shaded portions show the percentages of decrease throughout the States named during the last 15 years, according to the reports made to the New York Zoological Society.



our rapidly disappearing wild life. The correspondence is published in detail, and a large edition of this special paper in the Annual Report has been ordered for distribution in various parts of this country where it will be of the most service.

During the past year four honorary members have been elected to the Society as follows :

Mr. Arthur Erwin Brown, Philadelphia Zoological Gardens.

Professor Daniel Giraud Elliot, Field Columbian Museum, Chicago.

Dr. C. Hart Merriam, Director of the Biological Survey, U. S. Department of Agriculture, Washington, D. C.

Dr. Philip Lutley Sclater, Secretary of the Zoological Society of London.

Public interest in this project has been stimulated by means of popular illustrated Bulletins. The Annual Report also is fully illustrated by engravings showing the Park as it is, and the London Zoological Gardens. A large colored map, executed by the Matthews-Northrup Co., of Buffalo, is included in report, and shows in detail the final plan as approved by the Society and the City.

HENRY F. OSEBORN.

ENGINEERING NOTES.

THE opportunity for further improvement in the manufacture of armor-plate and consequent reduction of cost and price is well seen in comparing prices of this class of steel with those of other and more familiar sorts. With rails costing but \$15 to \$17 a ton, $\frac{3}{4}$ cent a pound, to make and selling at fifty per cent. higher figures in the market, and armor-plate at the following quotations, say at 25 cents a pound, there is obviously a grand opportunity for the mills to make money to-day and the inventor and the breaker of the monopoly to make more money later. The figures which follow are taken from bids of various makers for armor-plate to be supplied the Russian

government recently. The first two firms are English; the next four are French; the next two German and Austrian, and the next two American; the last is Russian:

	All round						
	Price.	9 in.	8 in.	7 in.	6 in.	5 in.	4 in.
	£	£	£	£	£	£	£
Vickers, Sons, and							
Maxim	117	—	—	—	—	—	—
John Brown	115	—	—	—	—	—	—
St Chamond	—	98	99½	—	—	108	110
Schneider et Cie...	—	100	—	106	—	111	114
Chattillon.....	—	97½	99½	103½	—	113	—
Marrel Fieres.....	—	—	—	—	106½	—	116½
F. Krupp, Essen..	112½	—	—	—	—	—	—
Dillingen	112	—	—	—	—	—	—
Bethlehem Co. ...	106	—	—	—	—	—	—
Carnegie Co.	106	—	—	—	—	—	—
Witkowitz	90½	—	—	—	—	—	—

The highest figures are submitted by English firms. The American bidders offer the lowest terms tendered by makers whose work is well-known and of the highest existing quality. They received the last Russian contract at their own figures and in spite of the lower offers of the French and Russian firms and the close figures given by Krupp. No award is yet announced for the present tender.

FRENCH builders and users of 'motor cycles' are apparently more active and enthusiastic in that new field of enterprise than are those either of the other European nations or of the United States. Frequent reports of competitions in which high speed and long routes have been distinguishing characteristics come to us, from Paris, particularly, and in some cases the reported results are exceedingly interesting and suggestive. The 'Criterium des Motor Cycles,' from Étampes to Chartres and return, occurred early in the present month. The run was 100 kilometers. There were fifty-three entries, twenty-eight actually taking part in the contest. In fine weather, but in a strong wind, M. Leon Bollée made the run in 1 hr., 57 min., 49½ sec., his nearest competitor making the time 2 hrs., 20 min.,

53½ sec. The winning vehicle had an 8 h. p. motor with two cylinders. The running speed of the victor was 51 kilometers (32 miles) an hour, unequalled by any road carriage to date, though closely approximated by steam-carriage makers sixty years ago in Great Britain. This speed is, of course, regarded as much too high for safety, on the excellent highways of France, even. The overloading of the carriage with power ruled out the motor-cycle of M. Bollée, as it was found to be in excess of the limit of weight; but this excess of power is considered by the builder to be justifiable for carriages intended to be employed in hilly countries.

R. H. THURSTON.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSICAL GEOGRAPHY OF NEW JERSEY.

THE Final Report of the State Geologist of New Jersey now reaches a fourth volume, which gives a serious discussion of the physical geography of the State by Salisbury. It replaces the first volume of this final series (now out of print), in which the topography of the State was described by Vermeule, and forms a valuable text for advanced students. After a general account of the physical features of the State, their origin is explained by means of successive cycles of erosion. The first erosion cycle developed the Schooley peneplain, now seen only in remnants on the even uplands of the Highlands, and in the long crestlines of Kittatinny mountain and of certain trap ridges. Next came the Cretaceous and Miocene submergences, separated by an erosion interval of small geographic import, and followed by the uplift which added the coastal plain to the State. An important cycle of erosion was thus introduced, during which a well-defined peneplain was developed on the weaker strata, leaving the harder as embossed ridges. A late submergence distributed the thin veneer of the

Pensauken gravels and sands over the drowned lowlands; and this was followed by an elevation in consequence of which the existing narrow valleys have been eroded in the 'pre-Pensauken peneplain.' The thoroughness of this volume only serves to emphasize the need of an elementary text, or series of brief explanatory tracts, that might go to the public schools along with the relief map of the State, already noticed in *SCIENCE*.

PHYSIOGRAPHIC TYPES.

THE first folio of the Topographic Atlas of the United States, published by the U. S. Geological Survey, is entitled *Physiographic Types*. It includes the maps of well-chosen typical regions, with explanatory text by H. Gannett. The Red River plain represents a young surface; the West Virginia plateau, a maturely dissected surface; the uplands of Kansas, an old surface, reduced nearly to a plain of denudation; Shasta is taken as a young volcano; Wisconsin affords examples of moraines and drumlins; the lower Mississippi gives the type of part of a flood-plain; Maine illustrates a drowned coast; and New Jersey, a sand-reefed coast. The policy indicated by the lucidity of the text that accompanies the geological folios is here well maintained. Great educational advantage must follow from it, not only in the better understanding of the Survey publications by their mature readers to-day, but even more in leading the younger generation towards a fuller comprehension of this large and growing store of material. The aid thus indirectly given by a great national organization towards the improvement of the position of geography and geology in the schools must everywhere be heartily welcomed.

The authority that this series of folios will exercise in matters of explanation and terminology makes it desirable that the greatest care should be exercised in their

preparation. There are some points in the first number that do not reach the desirable standard. For example, 'relief' is first defined in the sentence: "The land features, commonly called the relief, include all the variations of the surface * * *" It is correctly defined afterwards: "The relief, i. e., the difference in height between the stream beds and the divides." More direct evidence for the denudation of the piedmont region of Virginia is found in the deep-seated origin of the rock structures now at the surface, and in the discordance between structural arrangement and surface form, than in the great age of the rocks. The 'snag' explanation of drumlins is given a greater prominence than it deserves. The account of the Maine coast is erroneous in several respects. Glacial erosion is overestimated, and there are many exceptions to the statement that the thin soil of southern Maine is chiefly derived from postglacial disintegration; the soil is often deep, consisting of glacial drift, glacial gravels and sands, and marine clays now revealed in an irregular coastal plain which the farmers there know very well. "Ocean currents also bear sand along precisely as rivers do, depositing it where their force is checked," is a generalization that may mislead many an uninformed reader. It is unfortunate that a term so well understood as 'ridge' should be used to name the almost invisible swell of a river flood-plain, particularly in the publications of a Survey that is elsewhere so careful not to exaggerate the vertical scale of its sections.

W. M. DAVIS.

CURRENT NOTES ON METEOROLOGY.

CYCLONES OF THE PHILIPPINE ISLANDS.

FROM the Observatory of Manila, which has already given meteorology many valuable publications, comes a report upon the cyclones of the Philippines, written, as Father Algué, its author, tells us in the in-

truduction, amidst rumors of wars and war-like preparations *Baguio 6 Cielones Filipinos. Estudio Teórico-práctico*. This monograph of over 300 pages is the first complete publication upon the cyclones of the Philippines. It is of especial importance just at the present time, when the Philippines, long of peculiar interest to meteorologists, are becoming of interest to the general public of this country as well. The origin, structure, movement, paths, meteorological characteristics, and prognostics, are fully considered, and detailed accounts of certain special cyclones are given. Fifteen figures accompany the report, including a chart showing the average tracks of cyclones in the East, based on the international observations from 1878 to 1888, and on the Manila observations from 1865 to 1896.

PHYSIOLOGICAL EFFECTS OF HIGH ALTITUDES.

A SHORT paper by Douglass on the *Effects of High Mountain Climbing* (Appalachia, Vol. VIII., No. 4, 1898) summarizes the more important symptoms of mountain sickness as noted by previous climbers, and adds a few notes from the author's own experiences. The author is of the opinion that in trips which require two days to reach the summit of the mountain, as, *e. g.*, the ascent of Popocatepetl and Orizaba, the night should be passed at an altitude where mountain sickness is not likely to prevent sleep, that is, at about 13,000 ft. The increased discomfort from mountain sickness during the night, and the fact that all the symptoms become exaggerated with increasing elevation above sea level, make it advisable to sleep at as low an altitude as possible.

FOG ON THE NORTH ATLANTIC OCEAN.

ON the *Pilot Chart of the North Atlantic Ocean* for May, 1898, a new scheme for indicating the probable prevalence of fog is adopted for the first time. Instead of showing the regions of fog in one shade of color-

ing, as has been done hitherto, the present scheme gives a much more detailed forecast. Seven different styles of blue shading are now used, indicating seven degrees of probable duration of fog, in percentages. These percentages are as follows: 10%-20%, 20%-30%, 30%-40%, 40%-50%, 50%-60%, 60%-70%, and over 70%. That this more detailed forecast of fog duration will be very acceptable to mariners there can be no doubt.

CLOUD STUDY AND PHOTOGRAPHY.

AN attractive little book of eighty pages, entitled '*La Photographie et l'étude des nuages*,' by Boyer, presents, in four chapters, an account of the classification of clouds according to the International System; of the application of photography to cloud study, and of the calculation of cloud heights and velocities from the photographs. There are several good illustrations of cloud forms, reproduced from the cloud sheet of our Hydrographic Office, from the '*International Cloud Atlas*,' and from photographs taken at the Observatory at Trappes.

R. DEC. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOGRAPHY OF WESTERN ASIA.

THE races of western Asia were the subject of an important communication by M. Chantre to the French Association for the Advancement of Science at its last meeting. His conclusions were based upon about 25,000 measurements, including those of 100 women of high cast taken by Madame Chantre. They were altogether derived from 16 different stocks. They differed widely, showing that the population is from very varied sources. In reference to the cephalic index, for example, we have, on the one hand, the Kurds with an average index of 72, and on the other the Baktiars,

whose index averages about 90. On the whole the broad-skulled type predominates, being, as compared to the long-skulled type, in the proportion of 8 to 3. The complete publication of these important results has not yet been made.

BIBLIOGRAPHY OF PERU.

THE 23d publication of the Field Columbian Museum is a 'Bibliography of the Anthropology of Peru,' by Dr. George A. Dorsey. It is a neat octavo of 206 pages and must contain nearly 3,000 titles. This is proof enough of its value to students, and we venture to hope that it will not be the last work of the kind by its author, though in his preface he says it will be.

How impossible it is, however, to reach completion in such a task! Confining myself to the works in my own library, I find that Dr. Dorsey does not mention the papers on Peruvian mummies by Schuch and Cornalia, nor that on Peruvian gems by Blondel, nor any by the distinguished collector, Dr. Contzen, nor the valuable archaeological catalogue of Macedo, nor the essays on Peruvian mythology by Lafone, and, more painful to relate, he says nothing of my articles on the Puquina language, omitting also those of Grasserie on the same tongue. This merely shows that the greatest care sometimes fails.

THE LAMP OF THE ESKIMOS.

It has been noted that no form of lamp (with one doubtful exception) was known in ancient America south of the Eskimos. These possessed one from time immemorial. They could not, indeed, live without it. A study of it is presented in the *American Anthropologist* for April by Mr. Walter Hough. He considers it an independent invention. The rudest are merely stones collected on the beach with natural concavities in which the fats or oil can be poured and the wick laid at the side. Other stones were hollowed out to imitate

these. At St. Lawrence Island lamps of pottery are frequent. The size and form of the lamps curiously enough bear so distinct a relation to the isothermal lines that it is possible by comparison to assign the geographic position to any specimen.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

SUMMER SCHOOL OF THE ILLINOIS BOTANICAL STATION.

A SUMMER school of biology will be held at the Illinois Biological Station, Havana, Illinois, under the auspices of the University of Illinois, adapted to the purposes of university students; the instruction will also be carefully adjusted to the needs of teachers of biology wishing an opportunity for personal studies, in field and laboratory, of the plants and animals of a peculiarly rich and interesting situation and of the methods of modern biological station work. Four regular courses will be offered to organized classes, two in zoology and two in botany; and in addition to these opportunity will be given to students of experience to take independent work on special subjects, and to visiting investigators to pursue their personal researches at the station with the use of its equipment. The regular courses will be open to all who satisfy the management of their ability to do the work. The session will begin June 15th and continue four weeks, but members of classes may continue their work independently until August 1st. Visiting investigators may come at any time and remain until September 15th, and teachers may enter at any date preceding July 1st.

Visiting investigators will be given tables on the floating laboratory of the biological station. They will find in the locality a very rich fauna and flora in a greatly varied environment. Exceptional opportunities are offered for work on the lower algæ and the fleshy fungi. Over ninety species of Mycetozoa occur at Havana during the summer months. The abundance of Protozoa, Rotifera, Entomostraca, aquatic insects, planarians, oligochaete and parasitic worms, Mollusca—especially Unionidæ and

Bryozoa—and the ease with which material can be obtained, greatly facilitate morphological, experimental or systematic studies upon these forms. Havana is also an important fishing point, and the common fish and turtles of the Mississippi Valley can be obtained in abundance. The library facilities of the University and of the State Laboratory of Natural History will be open to investigators. This makes available the leading morphological journals and an exceptionally complete collection of the literature of fresh-water fauna and flora. Necessary laboratory equipment of glassware and reagents will be provided, though visitors are requested to furnish their own microscopes, expensive reagents, and alcohol for collecting purposes. Lists of literature and other desiderata should be in our hands by June 10th. The equipment of the Biological Station—steam-launch, row-boats and collecting apparatus—will be available for field work.

For the general objects, methods and organization of the school the Director of the Biological Station, Professor S. A. Forbes, is primarily responsible. The session will be under the immediate management of Dr. C. A. Kofoid, Superintendent of the Station and assistant professor of zoology at the University, who will also supervise and provide for the work of advanced students and investigators. The regular zoological courses, major and minor, will be taught by Professor Frank Smith, assistant professor of zoology at the University, and the botanical courses by Mr. Charles F. Hottes, University instructor in botany. The services of other members of the Station staff and of the University biological departments will be drawn upon for instruction in the special lines with which they are most familiar.

A fee of \$10 a month will be charged each student and each occupant of a biological station table. Membership in the regular classes will be limited to fifty students and the number of visiting investigators to twelve. Those purposing to attend will secure their places and confer a favor upon the management by making early application, accompanied by a statement of their preparation for the work. Other things being equal, college and university students and teachers of biology in the public

schools will be given the preference. Further particulars may be obtained from Professor S. A. Forbes, Urbana, Ill.

THE THIRD INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

DR. H. W. WILEY, Chairman of the American Committee of Organization for the Third International Congress of Applied Chemistry, to be held at Vienna beginning on July 28th, writes that the Organization Committee requests the American chemists wishing to send contributions to that Congress, either papers or reports of any description, to transmit the full title, together with an abstract of the papers, as soon as possible, to Professor Dr. F. Strohmer, IV/2 Schönburgstrasse Nr. 6, Wien, Austria. It is desired to publish the full program of the papers to be presented in the near future, and American chemists are earnestly requested to send forward their contributions without delay.

A local committee has been formed at Vienna for the purpose of securing agreeable and cheap dwelling places for foreign members during the continuance of the Congress. Those wishing to engage such places should address: Wohnungscomite des III internationalen Congresses für angewandte Chemie, Wien IV/2 Schönburgstrasse 6.

American chemists are also informed that, on account of the Jubilee Exposition to be held in Vienna from the 7th of May to the 8th of October, this year, the Austrian railroads are prepared to furnish round-trip tickets to all points in Austria-Hungary at greatly reduced prices. A further communication from the Railroad Committee will be made to American chemists in a short time concerning this matter. The North German Lloyd Steamship Company has also made reductions in fares to members of the Congress, regarding which further information may be obtained from Dr. Wiley.

GENERAL.

ARRANGEMENTS have now been made for the day to be spent at Harvard University during the Boston meeting of the American Association for the Advancement of Science. The various buildings and departments of the University will be opened for inspection. A

luncheon will be served in Memorial Hall, and later in the afternoon the corporation will give a garden party and tea in the Hemenway Gymnasium. At eight o'clock in the evening President Eliot will address the Association in Saunder's Theatre.

A CIRCULAR has been issued by Professor Foster, President of the Fourth International Congress of Physiologists, which meets at Cambridge from August 21st to 26th, giving information regarding accommodations. Many of the colleges have offered rooms for the use of members which will be furnished free of charge, beyond a small sum for attendance. Ladies cannot, however, reside in the colleges, but lodgings in the town are provided at a cost of less than \$1.00, including light and attendance, and meals can be taken in the college halls. Those wishing to secure lodgings or hotel accommodation should address Dr. Shore, the Local Secretary, at the Physiological Laboratory, Cambridge.

THERE will be held, as we have already noted, a biological exhibition in connection with the visit of the British Association to the city of Bristol. It is proposed to hold this exhibition in the gardens of the Bristol and West of England Zoological Society, and to offer as complete an exhibition as possible of recent investigations into the life history of animals and plants. A working committee has been formed and Sir John Lubbock has consented to open the exhibition.

At a meeting of the Washington Academy of Sciences, held on May 27th, nineteen new members were elected. Most of these were nominated by a committee acting on behalf of the Medical Society of the District of Columbia, recently added to the group of affiliated scientific societies represented in the Academy.

A TRIO of eminent German travelers and anthropologists are now in this country for the purpose of study. Dr. Karl von den Steinen, widely known through his travels in South America, and his two important works and minor publications relating thereto, has recently reached the eastern United States after a trip through the Southwest. Dr. Paul Ehrenreich, of Berlin, is now in New York en route to the

Pueblo country. Dr. Albrecht Wirth, of Frankfort, known through researches in Eastern Africa, and more recently through a work on Formosa, has just returned from the Far East, through Corea and Siberia. He is now in Washington.

DR. F. W. TRUE and Professor W. H. Holmes, of the United States National Museum, have recently gone to Omaha to supervise the final installation of the Smithsonian exhibit and to attend the formal opening of the Exposition. The Smithsonian exhibit at Omaha is rather more limited than were the displays at Nashville and Atlanta, owing to limitations in space and funds; but the arrangement is considered highly effective and satisfactory.

THE Geological Department of the Johns Hopkins University has just closed an encampment of several weeks near Cumberland, Maryland, in the heart of the Appalachian Mountains. Work was suspended in Baltimore during the period of the camp, special courses being given at Cumberland, both by the regular corps of instructors and by lecturers secured from the scientific bureaus in Washington. Complete instrumental outfits employed in geological, topographical, climatological, hydrographical and agricultural investigations were installed at the camp, special lectures being given upon their uses. In addition to practical work along geological and topographical lines, meteorological observations were taken twice daily by the students under the direction of an observer detailed by the United States Weather Bureau, the streams were gauged and the velocity and volume of their outflow determined, and the conditions of the soils in their temperature and moisture contents were examined daily under competent supervision. Among those who were present at the camp and who aided Professor Clark and his associates in the work of instruction were Messrs. Bailey Willis, H. M. Wilson, O. L. Fassig, E. G. Paul and C. W. Dorsey, of the Washington bureaus. It is planned to continue practical field work in this manner in subsequent years.

THE fourth annual address before the Botan-

ical Seminar of the University of Nebraska was given by Dr. Charles R. Barnes, of the University of Wisconsin, on Saturday evening, May 21, 1898. The Conjugatae and higher Bryophyta were cited as illustrations of 'Evolutionary Failures,' the subject of the address. The Seminar will publish the address in the near future.

THE department of botany of the University of Nebraska has prepared two 'Laboratory Units' for high school botanical laboratories, for exhibition in the Trans-Mississippi Exposition. Each includes those pieces of apparatus which are absolutely necessary for the student in the high school who is preparing to enter the University. The first of the 'units' is supplied by an American maker for \$23.00, and the second is imported duty free by another dealer for \$20.00. School officers can thus readily determine what to purchase and what the expense will be.

DR. HERMANN SCHAPIRA, professor of mathematics at the University of Heidelberg, died at Cologne on May 9th, at the age of fifty-seven years. The death is also reported of Mr. Maurice Hovelacque, Secretary of the Geological Society of Paris.

MR. ARTHUR E. KENNELLY has been elected President, and Mr. Ralph W. Pope has been re-elected Secretary, of the American Institute of Electrical Engineers.

PROFESSOR KALKOWSKY has been appointed Director of the Mineralogical, Geological and Ethnological Museum in Dresden.

PROFESSOR MAX VON PETTENKOFER, of the medical faculty of the University of Munich, has been elected a corresponding member of the Berlin Academy of Sciences.

PROFESSOR W. ROUX, who holds the chair of anatomy at Halle, has been elected a corresponding member of the Turin Academy of Sciences.

DR. EDWARD STRASBURGER, professor of botany at Bonn, has been elected a foreign member of the Danish Academy of Sciences.

AN address and some valuable plate were presented to Sir William Stokes on May 7th, on the occasion of the completion of the twenty-

fifth year of his professorship at the College of Surgeons, Dublin. In the evening Sir William Stokes was entertained at dinner.

THE Philosophical Faculty of the University of Göttingen has awarded the Otto Vahlbruch prize for the greatest advance in science during the past two years to Professor Röntgen, of Würzburg. This prize was founded in 1896 and is of the value of 9,200 Marks.

DIE Senckenbergische Naturforschende Gesellschaft, of Frankfurt, has awarded its Stroebe prize to Dr. Camerer, of Urach, for a book on the Metabolism of the Child.

THE Berlin Society for the Advancement of Industry offers several prizes for work to be submitted prior to November, 1898. One of these is a silver medal and six thousand Marks, for electrolysis applied to mining, and one a first prize of 4,000 Marks and a second prize of 3,000 Marks for a method of measuring the amount of steam passing through a pipe. The Society further offers in 1899 the Tornow prizes (5,000, 3,000 and 2,000 Marks) for a history of the metals, which must not exceed 200 pages in length.

WILLIAM WESLEY & SON, London, have issued a catalogue offering for sale a large number of works on astronomy from the libraries of Rev. A. Freeman, M.A., F.R.A.S.; A. Marth, F.R.A.S., and J. R. Hind, F.R.A.S., late Superintendent of the Nautical Almanac Office, London.

WE are glad to note that at the annual meeting of the London Anti-vivisection Society the Chairman said that many felt disheartened at the slow progress of the movement; that the society had to struggle against want of sympathy; that they deplored the apathy of the public in the matter, and a resolution was passed expressing unqualified dissatisfaction with the existing act regulating vivisection, and with its administration by the Home Office.

THE *Iowa Health Bulletin* publishes letters given by 'doctors of medicine' in support of applications for pensions, of which the following are examples:

—, June 8, 1896.

Déar Sir,

Yours received I treted Wm. Akens after he cum Hoam from the serfis for polypup in his nosee and

Running soar in his pastur. The polypup from the nite are and exposure the wonde cum from the cick of a hoars. —, M.D.

—, February 30, 1897.

Sur,

I surtify I treted the sed sojer fum 18888 to Date — foarmerly his stumik tub was jined to his nervious sistem but now it air rotted off cosing grate expextoring and hard of breth. Your Obt. servent —, M.D.

AN examination will be held to fill a vacancy in the grade of Chemist at the New York custom house on June 9th. The salary of this office is \$3,400.

THE New York Library Association held its annual meeting at Utica, N. Y., on May 25th and 26th.

THE 36th University Convocation will be held at Albany on June 27th, 28th and 29th. Among the subjects proposed for discussion are: Extension of elective system in high schools and academies. Should the four-year high school course be enforced as the minimum prerequisite for all degree courses? Should a minimum for conferring degrees be fixed by law? How low may admission requirements be made without forfeiting the right to the name college? What recognition should colleges and universities give to diplomas of State normal schools? What, if any, college studies should be regarded as constants to be pursued in every course? In courses leading to liberal arts degrees what credit should be given for studies in engineering, music and fine arts? Should high schools regularly offer instruction in domestic science and in business, or should this training for particular callings be relegated entirely to special schools? Educational functions of wall pictures, photographs and lantern slides as coordinate with books in giving either information or inspiration. The influence on boys and girls of reading daily newspapers. In connection with the reception in the State Library on June 27th a new Indian Museum will be opened for inspection.

IN noting the appointment of Professor Keeler to the Lick Observatory *The Revue Scientifique* pays the following compliment to the atmosphere of Pittsburg:

L'Observatoire d'Allegheny ayant un ciel plus

transparent que celui du Mont Hamilton, M. Keeler avait offert de rester à la tête du premier de ces établissements si de généreux amis de la science souscrivaient un million de francs pour agrandir et doter l'Observatoire.

THE third meeting of the Pan-American Medical Congress is to be held in Caracas, Venezuela, in Christmas week, 1899.

IN an interesting article in the *May Forum*, Professor Willis L. Moore states that the Weather Bureau intends to establish tentatively fifteen or twenty stations between the Alleghanies and the Rocky Mountains during the present spring, and to make special effort to secure observations at the same hour at a high level from all the stations, so that the meteorological conditions at that altitude may be compared with those prevailing at the surface of the earth. If we are successful in attaining the desired altitude at enough of our stations each day to give the data from which a synoptic chart can be constructed we shall then be able to map out not only the vertical gradients of temperature, humidity, pressure and wind velocity, but also the horizontal distribution of these forces at two levels—one at the earth's surface and the other at the height of one mile. It may be that after this work is done only negative knowledge will be acquired, but even then the work will not have been in vain. It will be an instructive study to note the development and progression of storms and cold waves at this high level. At that altitude the diurnal variations cease; there is but little change between the heat of midday and that of midnight, so that storm conditions may be measured without the confusing effects due to immediate terrestrial radiation.

THE Botanical Club of Barnard College has handed to the Treasurer \$500 to form the nucleus of a fund for the equipment of a botanical laboratory to be known as the Emily L. Gregory Botanical Laboratory.

MR. JOHN NICHOLS has added the sum of \$45,000 to the \$200,000 which he gave about two years ago for a library building for the city of Providence.

THE State Institute for Serum Research is being removed from Berlin to Frankfort, that

city having undertaken to erect a building for the Institute at a cost of 125,000 Marks.

THE annual horticultural exhibition was held in Paris from the 18th to the 25th of May and a Congress of Horticulture met in conjunction with the Exposition on May 20th and 21st. The Royal Botanic Society, London, held an exhibition of plants and flowers in their gardens at Regent's Park on May 11th.

WE learn from *Natural Science* that Mr. Edouard Foa has travelled across Africa by the basin of the Zambesi, Lake Tanganyika and the Congo, and has brought back numerous specimens of anthropological interest from the region of the great lakes. Dr. Hugo Bücking and Dr. L. van Werneke have started for an eight months' expedition to the Netherland East Indies on behalf of a Dutch Society.

WE receive monthly the *Sei-ikwai Medical Journal*, edited and published by the Society for the Advancement of Medical Science in Japan, the articles of which, partly in English and partly in Japanese, are doubtless instructive to the Japanese, while those in English are certainly amusing to the English reader. The general style may be gathered from the following:

"Diseases of the animal sphere (or the nerves, senses and muscles). Regarding Japanese pathological constitution the writings of medical and ethnographic authors are not lacking in general remarks which are meant to express in the usual sense. * * * * It would also be an essential task of the surgeon to separate such easings of the treatment of wounds as really are due to constitutional causes, from the consequences of the possibility that perhaps the causes of infection working against the healing art is some way different extra European countries. * * * * The spleen is all malarial, typhus, variola diseases and in those called *kas e'zokyu* splenetid diseases, the seat of strong swelling and all corresponding symptoms. Let us observe here that unusually great swellings of the spleen are seldom found, either in post-mortem or clinical examination."

UNIVERSITY AND EDUCATIONAL NEWS.

It is said that Mrs. Phoebe Hearst will erect a building for mining engineering for the University of California at a cost of \$300,000.

MR. HENRY WILDE, F.R.S., has proposed to

endow in Oxford University a readership and a scholarship in mental philosophy. They are to be designated the Wilde readership and the John Locke scholarship.

HOBART COLLEGE, Geneva, N. Y., received \$6,000 for a scholarship by the will of Mrs. Augusta M. Williams, of Newport, R. I.

THE appointments for the coming year in the botanical department, Cornell University, are as follows: Dr. E. J. Durand is reappointed instructor in botany and assistant curator of the Cryptogamic Herbarium, and Mr. K. M. Wiegand, assistant in botany and assistant curator of the Phaneogamic Herbarium. Mr. B. M. Duggar, now assistant cryptogamic botanist to the Experiment Station, has been appointed instructor in botany, with special reference to experimental plant physiology, his time to be divided between instruction and work in the Experiment Station. Two graduate assistantships in botany have been established, the holders to divide their time between assistance and investigation. Mr. W. A. Murrill, B.S., A.M., the present scholar, and Mr. G. T. Hastings have been appointed to these positions for the coming year. Besides these, a fellow, or scholar, is appointed in the department.

THE second summer session of the New York State Library School, Albany, of which Mr. Melvil Dewey is Director, began this year on May 30th, and will continue in session for five weeks.

AMONG the 'docents who have recently qualified are Dr. Fischer in anatomy and Dr. Mayer, of Vienna, in chemistry at the German University at Prague; Dr. Formanek in applied medical chemistry in the Bohemian University at Prague, and Dr. Haussner in mathematics in the University at Giessen.

DISCUSSION AND CORRESPONDENCE.

COLOR-VISION.

It is not often that a letter appears in SCIENCE that presents the particular combination of characteristics of one of the recent communications on Color Vision. Professor Titchener says expressly that until the recent papers of Müller in the *Zeitschrift für Psychologie* on Her-

ing's theory of Color Vision he has been content for several years to know the subject only in the compendiums of Helmholtz, Wundt and Hermann, and in the original paper of Hering of 1874, and yet he finds himself able to lay down the law in an *ex-cathedra* fashion that one would usually not be willing to indulge in, in regard to a confessedly undecided question, after a long devotion to the subject. That his reading has been cursory, and has been apparently to a certain extent forgotten, is evident from his making in a few lines such mistakes as to attribute the idea of the shift of excitability in photo-chemical substances to König, and to refer to the Helmholtz theory as a three-fibre theory. Fick is usually and not improperly credited with the idea of the 'shift of excitability,' as it is he who first made much of it in the explanation of color-blindness, but the idea is originally due to Helmholtz himself, and occurs already in the first edition of his 'Optics.' To say, therefore, of Helmholtz's theory that 'its original and most attractive simplicity has been given up in favor of König's shift of excitability' is to show a rather unusual degree of ignorance of the facts of the case. It is also doing much injustice to the Helmholtz theory to designate it as a three-fibre theory; the assignment of the three chemical substances to three separate fibres was, in the first edition of the 'Optics,' expressly stated to be merely a mode of facilitating speaking about them, and since the time of its experimental disproving in Helmholtz' own laboratory it has naturally been abandoned by him.

The present discussion of color-vision in SCIENCE has been occasioned by Professor Patten's having had the temerity to bring out an entirely new theory, the main feature of which is that it is an endeavor to take account of a peculiarity of the structure of the retina which is certainly there, and which as certainly does not exist without having some function. Professor Patten's full paper on the subject has not yet appeared; when it does it will no doubt receive a due measure of attention from the physiologists and the anatomists, to whom it makes its chief appeal; any great psychological inadequateness is hardly to be looked for, at the hands of its author, in view of the full dis-

cussion which considerations of this sort have received in recent years. But it seems hardly courteous to condemn a theory before it has had a chance to be heard; any new theory, from the nature of the case, makes its appeal to those only who have the leisure and the open-mindedness (or the idle curiosity, as it may turn out to have been) to give it a fair share of attention. For a fresh theory to be set down as unnecessary and absurd is no new experience; the most recent (and classical) example of the sort is the notice with which Kolbe greeted Van't Hoff's conception of the different positions of atoms in space, which has since assumed such fundamental importance for chemistry. He said: "If any one supposes that I exaggerate this evil [of erratic speculation] I recommend him to read, if he has the patience, the recent fanciful publication of Van't Hoff and Hermann" (Hermann being the German translator). It cannot, therefore, be looked upon as altogether a bad omen that the first feeling excited by a new theory is one of irritation and impatience.

My own theory met with the great good luck that, at the end of a year after it was brought out, the President of the British Association happened to take, as the subject of his presidential address, a topic which included color-vision; after full and careful discussion of the subject, he stated that the known facts in the case (and especially those recently discovered) were best explained by my theory. It is a piece of good fortune, again, that the physiologists of this country have happened just at this time to bring out a large and important general work on Physiology; this has given Professor Bowditch occasion to give my theory generous space and a very fair showing. As a Vice-President of the American Association, Professor Le Conte Stevens has also happened to have color-vision for the subject of his inaugural address; and the author of the best English compendium on sight, Professor Joseph Le Conte, has happened to bring out a new edition of his little book; I have to thank them both for the courteous treatment which they have given my attempt to account for the phenomena of the sensation of light. All this I regard as a piece of good fortune, such as does not always attend upon

merit in this too busy world, and I hope that Professor Patten, if he happens to have hit upon a fruitful idea, will have an equally early opportunity to secure a hearing.

While my theory has had much good luck in the way of a favorable reception, it has hitherto been rather lacking in the honor of being attacked. I am, therefore, very glad of the opportunity which is now given me for elucidating some of its features. Professor Titchener disposes of my hypothesis in summary fashion by saying, first, that my assumed molecules have a suicidal tendency, and, second, that there is experimental evidence against the theory. The reply in the case of both of these counts is very simple. I take the second one first:

1. There is no experimental evidence against my theory. There is experimental evidence against the four-color component theory of Donders, but it does not hold against my theory, in which there are not two different kinds of white-sensation. Moreover, the attempt which has been made to show that this same evidence does not hold equally against the four-color theory of Hering can hardly be said to be successful.

2. It is incorrect to say that I assume, among the properties of my photo-chemical substance, a suicidal tendency; it should be said at most that it has a *semi-suicidal* tendency. The photo-chemical substance which I assume is as stable as any other physiological substance in its first estate; it is only that it becomes unstable after it has suffered a partial decomposition. As a matter of fact, after we have had a vision of blue for a certain length of time we find that it is followed, even though the eyes be closed, by an after-vision of yellow. This is a marked defect in the optical apparatus with which nature has provided us, and a defect from which we do not suffer (to any appreciable extent) in the case of the other senses; the sound-sensation of a given note is not followed by an after-clap of a definite other note. Nature might have done much better for us if she had provided some light-process which was not open to this source of error, but as she has not we must do the best we can to make out the character of the process which she has given us. Whatever

that process may be, it is plainly something such that, after the external world has sent in to us information regarding a given colored surface, retinal equilibrium has to be restored by a subjective vision of the complementary color, even at the cost, if the eyes be open, of making objects which are really white take on a deceptive appearance of being colored. This fact of nature is mirrored in my theory by supposing that after having undergone a partial decomposition the photo-chemical substance concerned becomes unstable and breaks down completely. This is *zweckmässig*, because the retina becomes in this way a *tabula rasa*, and is thus able to give us correct information regarding the color that next impinges upon it. It had not occurred to me that the idea of a chemical compound which, on being partly decomposed, left an unstable residue was so recondite a conception as to need to be fortified by authority or by example, and, upon consulting the chemists whom I have access to, I find that I am right in this view. But if examples are needed they can easily be given in any quantity. Many unstable phenols, as pyrocatechin and pyrogallie acid, form stable compounds when treated with acid chlorides as benzoyl chloride or acetyl chloride. When these compounds are decomposed, so that benzoic acid or acetic acid, as the case may be, is formed, and the stable acids are removed, the very unstable phenol is left in solution. And it is not even necessary to go so far as to organic chemistry to find instances. So elementary a process as the removal of an atom of oxygen from sulphuric acid leaves an unstable remainder which gradually separates into water and sulphurous anhydride.

It cannot be too much insisted upon that the after-image which follows the vision of a colored surface is something peculiar and consequently demands something *sui generis* in the chemical conception which is to account for it. Müller, in fact, points out that, if the after-image is to be explained by the play of assimilation and dissimilation, the evident objection presents itself that corresponding after-effects ought to occur in other regions of the animal mechanism as well. The only way he has of meeting this objection is to say that any explanation of the

visual process which was based upon *general* properties of the nervous substance would be open to the same objection. This is true, and it applies to Müller's own explanation of the phenomenon in question with peculiar force. But the conclusion to be drawn is not that one visual theory is sure to be just as good as another, but rather that that theory which posits a chemical process which is *not* exactly like what goes on everywhere else in the body has by so much the advantage over another theory. The idea of a photo-chemical substance which is unstable after a partial dissociation, which it is as far as possible from being a remote idea to the chemist, is *just as far* removed from our conception of other physiological processes as it *must be*, in a well-devised theory, in order to account for anything so extremely distinctive as is the visual after-image.

But even though it had been necessary to go very far afield for the conception of a semi-suicidal chemical substance, this could not have been counted, by any one who had given a moment's consideration to the subject, as a point of superiority on the part of Hering's theory over mine; for his assumed photo-chemical substance is 'suicidal' from the start. If blue is the color of assimilation, then after we have looked at a blue surface for a few moments there has been piled up in the retina, according to Hering, a large amount of the blue-yellow substance, and it is the going to pieces of this immediately afterwards which is the cause of the after-image; this assumed process is not in itself an objection to the theory, but it is 'suicidal' to the last degree.

Professor Müller's recent papers in the *Zeitschrift für Psychologie* are a monument of learning and acumen, as I have already said in the pages of *The Psychological Review*. How far they are from substituting for the original theory of Hering a theory which can lay any claim whatever to being considered an adequate account of the phenomena of color-vision I am about to show in connection with a general discussion of color theories. Meantime I rejoice in the fact that Professor Titchener has renewed his study of the subject of color. It is to be hoped that this will lead him to remodel the brief statements regarding color which are found

in his book on Psychology; what he says there (while it is not incomprehensible to one who has the clue to his secret meaning) must seem contradictory and confusing in the extreme to the ordinary reader, and certainly constitutes a serious blemish in a book which is otherwise not simply a good text-book, but a valuable contribution to the science of psychology.

C. LADD FRANKLIN.

BALTIMORE.

A PRECISE CRITERION OF SPECIES.

TO THE EDITOR OF SCIENCE: I thank you for the suggestions contained in your kind discussion in SCIENCE, No. 178, of Mr. Blankinship's and my paper on a 'Precise Criterion of Species.' Our paper was concerned with a method which, if applied, will constitute a small, but, we think, important, step toward giving greater precision to the defining of particular species and to the distinguishing of varieties from species. To my mind the only important objection urged so far, an objection which was anticipated, is that it is impracticable to use in systematic work so great precision as our method calls for; it takes too much time and too large a number of individuals. *A priori* argumentation cannot dispose of this formidable objection; only the demonstrated advantage of the method in practice can avail against it. I should like to urge anthropologists, mammalogists, ornithologists, ichthyologists, malacologists and others who have already gone some way in the direction of applying statistics to species to put the method to practical test. Mr. Blankinship and I are doing so. I should be very glad to assist those who meet with difficulties in the application of the method, as, for example, in the measurement of color and complex forms. The ingenious naturalist will find, however, as anthropologists have found, few, if any, specific differentiae which are not measurable.

C. B. DAVENPORT.

ELECTRICAL ANÆSTHESIA.

TO THE EDITOR OF SCIENCE: While making some experiments on the sensations derived from sinusoidal currents I noticed (April 12, 1898) that anæsthesia of the tissues resulted

from currents of high frequency, the condition lasting for some time after the removal of the electrodes. While in this condition the finger could be pricked with a pin without any resulting sensation except that of dull contact. Sensitiveness to cold was also removed. The investigation has been continued and has shown the possibility of employing a sinusoidal current of high frequency as an anæsthetic. Full details as to the requisite frequency and intensity will be published later.

E. W. SCRIPTURE.

YALE UNIVERSITY,
NEW HAVEN, CONN., May 25th.

SCIENTIFIC LITERATURE.

The Sun's Place in Nature. By SIR NORMAN LOCKYER. London and New York, The Macmillan Company. 1897. Pp. 360. Price, 12 shillings.

The character of this latest work of its eminent author might, perhaps, be misunderstood from its title. It discusses the Sun's place in the order of evolution of the stars, and not in relation to the solar system. It is, therefore, to be classed as a book on stellar astronomy, and is to a considerable extent based upon a course of lectures recently delivered by the author at the School of Mines in London. The nature of the work may best be shown by quoting in full the conclusion: "I am not aware that any more crucial test than the foregoing can be applied to the rival schemes of stellar classification, and, as I hold that the result of its application is entirely in favor of the one which assumes the existence of some stellar bodies which are increasing their temperature while others are reducing it, the Sun's place in Nature must be regarded as near that occupied by Arcturus and Capella, and very far separated from that occupied by α Cygni, γ Cygni, and α Tauri. Nor is this all, the origin of the Sun in a nebula not exclusively gaseous, but only containing gases among its constituents, is greatly strengthened by the extended study of the classification problem which has occupied the last few chapters. Along all lines, then, the fundamental requirements of the Meteoritic Hypothesis have been strengthened by the later work."

The book may be regarded, then, as a sequel

to 'The Meteoritic Hypothesis,' which appeared in 1890, and is intended to reply to the criticisms of the earlier work, as well as to present the author's view of the bearing on that hypothesis of the relevant discoveries in the intervening years. It is, therefore, not a book for the instruction of the general reader, unless he has a taste for argumentative reasoning, adduced in behalf of a theory which has not met with general acceptance. It is written in Sir Norman's easy style, and may readily carry the reader who is not critical along to the conclusions of the author.

An interesting account is given of the discovery of terrestrial helium and the investigations of its spectrum from various minerals, in which the researches of the author were early and important. Some seventy minerals were examined in his laboratory at South Kensington, and the D_3 line of helium was detected in the spectrum of sixteen of them.

It is an essential feature of the Meteoritic Hypothesis that nebulae are meteoritic in their nature, and that they pass into the stage of 'stars' as the meteoric 'swarms' become more condensed. Accordingly considerable space is devoted to the chemistry and nature of the nebula and their relation to stars. Professor Lockyer has himself obtained very successful photographs of the Orion nebula, and he gives a list of 54 lines on a plate taken in 1890. If there is any connection between nebulae and meteorites it would certainly be expected to reveal itself in some resemblance of their spectra. As a matter of fact, however, aside from hydrogen and helium, which are abundantly represented by lines, the only elements which Professor Lockyer identifies are calcium (three lines), iron, carbon and magnesium (one line each). Now Keeler's measures have demonstrated that the chief nebular line does not coincide with the magnesium line, and still less do the remaining lines agree in wave-length with the lines of the elements mentioned. Thus it appears that there is an entire absence of spectral similarity between nebulae and meteorites, except that both contain the universally prevalent hydrogen.

The references made to the work of Dr. Huggins, especially in connection with the

spectrum of the nebulae, can hardly be accepted as fair to that eminent investigator and pioneer in that line.

An interesting account is given of the appearances of the temporary stars, or 'Novae,' with their spectroscopic history, in which the observations of the author properly take a prominent place. Chapter XIV. is entitled 'How the hypothesis has fared,' referring more particularly to the bearing of the recent work on *Nova Aurigæ* upon the meteoritic hypothesis. The last quarter of the work discusses the problem of stellar classification. The principal contention of the author is that a spectral classification should provide both for stars that may be growing hotter as well as for those that may be growing cooler. The implication is that the adoption of this principle requires the acceptance of the meteoritic hypothesis, an implication recurring in other parts of this work. The necessity is, however, by no means obvious.

In the diagrams to show the difference in the spectra of stars considered by the author to be of increasing, and those of decreasing temperature, it would seem quite possible to exchange the labels under the cuts without seriously affecting the plausibility of the reasoning.

With that part of the final conclusion, already quoted, that locates the sun in close spectral proximity with Arcturus and Capella, no doubt all astronomers will agree.

The process illustrations of the book are not in keeping with its otherwise admirable typographical appearance, and are distinctly inferior to the excellent engravings in the earlier 'Meteoritic Hypothesis.'

EDWIN B. FROST.

Astronomy. By AGNES M. CLERKE; A. FOWLER, A.R.C.S., F.R.A.S.; J. ELLAED GORE, F.R.A.S., M.R.I.A. New York, D. Appleton & Co.

It is of supreme importance to a science that the popular writing representing it before the world of culture should be alike a graceful and an accurate exponent of the special subject. Astronomy seems in many instances to have been not too fortunate in the character of the literature promulgated as 'popular astronomy.' The unfortunate experience of this science leads

one then the more nervously to examine the credentials of a new recruit, and the more gratefully to welcome into popular astronomical literature a book of the honorable purpose and generally praiseworthy execution of the present volume.

'Astronomy' is divided into four chapters. In the first Miss Clerke submits a concise résumé of the history of astronomy; then follows a chapter on spherical, practical and gravitational astronomy expounded according to simple geometrical considerations by Professor Fowler; the third, also by Miss Clerke, reviews concisely our present knowledge of the solar system; the fourth and last is a concise treatise on the sidereal heavens by Professor Gore.

The prime question naturally suggested by the tripartite authorship is whether a triple responsibility is really necessary in connection with a book whose aim is for the most part popular. A superficial examination would also incline one at once to challenge so ambitious a combination of authors in a book of but 565 pages. Closer examination, however, seems fully to justify the threefold authorship. As a volume of 'The Concise Knowledge Library' it evidently aims both at great conciseness, scientific accuracy and freshness; and hence with the vast domain of astronomical science to be condensed into a moderate-sized volume it was clearly an advantage to have the work thus apportioned among several writers, each facile in the descriptive art and each faithful to the cause of scientific astronomy.

Considering the scope of the facts to be presented and the plan adopted, it would be beyond expectation to find a performance of this sort altogether blameless. Attempt at the required conciseness, coupled with an assignment of special subjects to each author under strict limitations, has seemed to exercise too restraining an influence. Subjects like modern astronomical spectroscopy and celestial photography have, taking the book as a whole, scarcely infused their full inspiration. The extreme brevity of the reference to far-reaching topics like 'tidal evolution' is almost tantalizing. Perhaps the character whose absence one misses most is direct discussion of astronomical methods and results from the standpoint of the active ob-

server. The flavor, while sufficiently literary, lacks a certain essence to be caught up only from the activities of the observatory.

And yet it was expected that a volume counting Miss Clerke, the graceful, accurate and forceful author of 'A Popular History of Astronomy during the Nineteenth Century,' among its sponsors would not be lacking in vital interest. Her contributions to 'Astronomy' have not fallen below her former high standard, except in very few particulars. Especially noteworthy and able are the pages on the history of the achievements of gravitational astronomy of the period immediately succeeding Newton. But by the time the modern stage of spectroscopic astronomy is reached one feels a lack of the former easy swing of her pen, and one also regrets to notice a trace of that peculiar English tendency to ignore foreign scientific achievement. How the judicious pen of Miss Clerke could refrain from setting in artistic relief the grand achievements of a Kirchhoff, while it does enthusiastic and just homage to a Huggins, is inexplicable except on grounds of excessive brevity. Truth to say, Miss Clerke has always seemed to repudiate insularity in all of her astronomical writings, and one would not tax her here with anything more than an unconscious bias, in certain particulars, toward her own countrymen, nor indeed generally with anything less than a most fascinating and powerful presentation of the thrilling discoveries and stupendous facts of astronomical science.

Professor Gore's review of the science of the stellar universe gives ample evidence of a determination to bring before the cultured public science fresh from its primal sources. Nearly every page bears evidence of faithful appreciation of the original contributions of astronomers and of a consistent assimilation of the vast mass of material. Although lacking somewhat in that vivacity of style characteristic of Miss Clerke, one is impressed with the conscientious fervour and decisive grasp of Professor Gore's presentation of subjects bristling with numberless suggestive facts and insuperable difficulties.

For Professor Fowler, the accomplished practical astronomer, so favorably known by his

successful observational work, was reserved the more or less thankless task of furnishing the more mathematical side of the book. Ever since Laplace, under an unlucky star, rashly attempted to put mathematics into words, in the celebrated *Système du Monde*, we have become convinced of the necessary inadequateness of ordinary language, and even of ordinary geometry, to the expression of this class of ideas. We cannot, therefore, harshly set forth the weak points which necessarily inhere in an attempt to compress all the marvels of mathematical astronomy into less than two hundred pages of a popular account. Rather would we express the genuine surprise which one experiences in following the author's ingenuity in presenting the difficult geometrical and dynamical conceptions of the astronomer. Most interesting is the complete and accurate though condensed review of the instrumental appliances characteristic of modern astronomy.

It would be a graceless act to close this brief review of a valuable addition to the popular side of astronomy without at once complimenting the American publishers on the fair typography, and condoling with them on the binding of a book of this character in a style bereft of every element of propriety and good taste.

M. B. SNYDER.

Lehrbuch der Entwicklungsgeschichte des Menschen. Von PROFESSOR J. KOLLMANN. Jena, Fischer. 1898. 8vo. Pp. xii + 658.

Embryological literature has been again enriched by a valuable text-book by Professor Kollmann (Basel, Switzerland). As the title indicates, the work deals preeminently with human embryology, comparative-embryological facts being adduced only in so far as desirable for a better understanding of corresponding processes in man. The book is furnished with a considerable number of good illustrations, of which a great many are original and entirely new. Preference is given to illustrations taken from 'plastic reconstructions' and so-called 'combined drawings.' Such illustrations are, of course, especially valuable for demonstrating complicated morphological structures which in the single sections of a series are only shown in fragments. It needs, however, to be

mentioned that a few of those plastic figures are somewhat unclear, apparently due to a failure in the execution of the original drawing.

The arrangement of the contents is very convenient. We find in the first part, according to the generally accepted plan, the description of the ovum, maturation, fertilization, cleavage, formation of the germ layers and the fundamental processes in development of the embryonic body, and finally the foetal membranes. The following chapter contains an exhaustive and very useful account of the growth and external development of the human foetus, especially during the first two months, together with some data on measurement and the determination of age.

The second part of the book deals with the development of the *special organs*. In arranging this material the author follows the customary method of systematic anatomy, describing first the development of the skeleton and the muscular system, and then going on with that of the intestinal tract, the circulatory apparatus, the nervous system, and finally the skin and the sensory organs. Such an arrangement has many advantages and is obviously adapted especially for medical students. Scattered through the descriptive text we find also some theoretical discussions which are usually marked off from the main text by smaller type. These discussions touch upon questions of special interest for a better appreciation of certain points in human ontogenesis.

In criticising the treatment of the material in Professor Kollmann's text-book one deficiency in the reviewer's opinion seems to be rather serious—that is, the almost absolute neglect of the *histological* differentiation of the tissues in general as well as of the different organs, together with a lack of figures illustrating these processes. These processes are not only of interest for the professional embryologist, but also to a high degree for the medical student, in so far as an adequate knowledge of them is of preeminent importance for a satisfactory understanding of so many physiological and pathological processes of the organs. Hence it seems to the reviewer that in a modern text-book of embryology this important part of development should not be entirely omitted,

all the more as recent investigations have thrown more light upon these very complicated processes, and as the field of *cellular embryology* will be more and more cultivated.

These deficiencies, however, in Kollmann's text-book do not interfere with its peculiar excellence, which lies in the exact *anatomical* treatment of the developing organism, together with the elucidation of the text by numerous very instructive illustrations. It is in this especially that the book forms a valuable addition to our embryological literature and deserves to be highly recommended. The different chapters are in general well balanced. The text is concise and clear. Print and reproduction of illustrations are according to the high reputation of the publisher.

ALFRED SCHAPER.

A Primer of Psychology. By EDWARD BRADFORD TITCHENER. New York and London, The Macmillan Co. 1898. Pp. xvi + 314, Price, \$1.

As the scientific claims of psychology are more widely recognized, there is an increasing demand for elementary text-books on the subject. Professor Titchener has in mind the difficulties of the beginner, and while there is more science and less glitter in this *Primer* than is common in courses of 'science made easy' it can scarcely fail to interest the novice as well as instruct him. The fundamental concepts are defined with unusual clearness, and every difficult point, as soon as it comes up, is carefully explained, often with the help of illustrations taken from literature or the physical sciences.

The *Primer* is not intended primarily as a course in experimental psychology. The body of the text is rather analytic, although the chief results of experimental research, such as Weber's Law, are given much space. As would be expected in a work by Professor Titchener, the whole treatment of the subject is largely influenced by this branch. Among the many practical exercises found at the end of each chapter, as much in the way of experimental demonstration is included as is practicable for classes with only a limited supply of apparatus at command. When on debated ground the author generally adheres to the theories

most widely accepted among leading psychologists, in preference to his own as expounded elsewhere. For example, he does not attempt to treat the *idea* as a centrally initiated sensation, but allows it a separate place in the analysis.

The arrangement of chapters is certainly logical, though it will probably not appear so to the beginner. The complexity of the subject is not adequately set forth, and (except on the active side) no analysis is given, such as would show the successive degrees of complexity. Thus the pupil is led, first through sensation, feeling and attention, then to perception, idea, emotion and simple action, and finally to memory, thought, sentiment and complex action. Unless his attention be specially called to the matter, he may easily fail to notice the close relation existing between sensation, perception and thought, or that between feeling, emotion and sentiment. A general scheme of these relations would have done much to clear up the subject in the mind of the novice.

The psychology of action is admirably treated, considering the difficulty of the subject. In the prominence given to attention, and the rejection of innervation feelings, Professor Titchener follows the trend of recent discussion. The question of the exact relation of action to consciousness is very properly avoided. On the other hand, impulse, reflex movement, instinctive action, etc., are thoroughly discussed, and this prepares the way for a scientific treatment of selective action and volition in a later chapter. The problem of the freedom of the will, which could scarcely be avoided in a volume of this character, is clearly set forth, and the discussion limited to its psychological aspect.

Perhaps the most noticeable departure from the accepted mode of treatment is found in the chapter on thought. The author makes judgment the primary thought-process. But he apparently limits the term 'judgment' to the first instance in which any particular judgment (as ordinarily defined) is made. "Judging," he says, "is a process of rare occurrence in consciousness. * * * Every generation receives a heritage of judgments from the preceding generations. * * * Even if we wish to judge for ourselves, there are so many past judgments

on record in books, and so many others to be had for the asking from our elders, that independent thought is difficult—it follows from all this that propositions like 'The grass is green' are not judgments at all; they do not express results which we have gained laboriously by active attention. That they have the form of judgment may be due either to the fact that they were judgments once, generations ago, or merely to the fact that we cannot utter more than one word at a time, and must, therefore, give the parts of our idea successively. It is only when * * * a total idea is actively divided up that true judgment occurs." (P. 217.) "The 'material' which is worked over and divided up by the attention in judgment" is the "*aggregate idea*." "A predicate which is common to several judgments is termed a *concept*. * * * The concept is always a word." (Pp. 218-219.) Again, he says: "Thinking is active imagination carried on in words." (P. 213.) Throughout the discussion one feels that too great emphasis is laid on words. Professor Titchener distinguishes sharply between imagination (imaging in kind) and thought and conception (symbolization in words); whereas the general position of psychological text-books would make it appear that the image is closely associated with the word, and accompanies it, as a 'fringe,' at least, in every process. This is not the place to discuss the theory, but it may properly be noted that the author departs here from his own rule that the generally accepted views should be adhered to in an elementary text-book.

The chapter on abnormal psychology includes sleep and dreams, hypnotism and insanity. The chief matters of interest to the beginner in these departments are well summed up; it would be impossible to give more than a summary in twenty pages. In the concluding chapter the province and methods of child psychology, comparative psychology, etc., are pointed out, and the relation of psychology to ethics, logic and pedagogy touched upon. At the end of each chapter throughout the volume are references to passages in other general works where fuller treatment of the topics can be found, while references in the body of the text to physiological and physical works enable

the reader to supplement the necessarily brief discussion of such topics. The apparatus for experimental work is well selected, and gives opportunity for typical demonstrations on almost every problem, with a minimum of cost, while many additional exercises are given, for which no special apparatus is needed.

H. C. WARREN.

SCIENTIFIC JOURNALS.

Journal of Physical Chemistry, May. 'The Transference Number of Hydrogen:' by Douglas McIntosh. An attempt to determine the transference number for hydrogen in different circles by the Helmholtz method, using gas electrodes, but it was found that the method is not applicable to gas cells, probably owing to the solubility of the electrode in the electrolytic solution. 'Single Differences of Potential:' by Hector R. Carveth. The conclusion is drawn that the values given by drop electrodes does not give true single differences of potential. 'Acetonechloroform:' by Frank K. Cameron and H. A. Holly. A study of the camphor-like substance discovered by Willgerodt formed by adding potassium hydroxid to a mixture of acetone and chloroform. From the formula of the substance it would appear to be a simple addition-product, but this is shown not to be the case, and it cannot be resolved into its constituents by direct means. While the substance contains water, it is present not as a hydrate, but apparently in a solid solution. Notes on new books, including an excellent review of the last edition of Mendeléef's *Principles of Chemistry*; *Journal Reviews*.

THE *Astrophysical Journal* for May, completing the seventh volume, opens with an article by Professor J. Wilsing, of the Potsdam Astrophysical Observatory, which argues that the results obtained by Messrs. Humphreys and Mohler on the influence of pressure on the wave-length of lines in the spectra of the metals can be explained as an effect of damping of the vibrations to which the emission of light is due. Mr. R. H. Tucker, of the Lick Observatory, follows with an article on 'The Correspondence of the Photographic Durchmusterung with the Visual.' Mr. C. W. Crockett, of the

Rensselaer Polytechnic Institute, reviews in two articles the caustic of the right parabolic cylinder and the parabolic mirror. Mr. Frank McClean contributes a paper read before the Royal Society on a comparison of oxygen with the extra lines in the spectra of the helium stars, as also a summary of the spectra of southern stars, and Professor H. A. Rowland and Mr. C. N. Harrison contribute the final article on 'Arc Spectra of Zirconium and Lanthanum.'

THE sixteenth volume of the *Educational Review* commenced with the June number, which includes the following articles: 'Harris' Psychologic Foundations of Education,' by John Dewey; 'Scope and Function of Secondary Education,' by Nicholas Murray Butler; 'Teaching European History in College,' by James H. Robinson; 'Religious Periods of Child-growth,' by Oscar Chrisman; 'Better Training for Law and Medicine,' by Charles F. Thwing; 'The Key to Rousseau's Emile,' by Samuel Weir, and 'Attitude of Massachusetts School Authorities toward a Science of Education,' by John G. Thompson.

SOCIETIES AND ACADEMIES.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE regular meeting was held on April 14th.

The first paper of the evening was read by Dr. Hillebrand and was entitled 'The Volumetric Estimation of Vanadium in the Presence of small Amounts of Chromium, with especial Reference to the Analysis of Rocks and Ores.' When chromium has been estimated colorimetrically, as detailed in a previous paper, the vanadium can, in many instances, be estimated without separation from the chromium by the well-known method of titration with KMnO_4 . With considerable chromium present the error is increased by the difficulty of getting sharp end reaction, due to the color of the chromic salt and to the oxidizability of Cr_2O_3 in hot solutions, but the author shows how to ascertain and apply a proper correction within certain limits.

The method is especially applicable to rocks, iron ores, clays, coals, etc., in which chromium is seldom an important constituent quantitatively.

Tables of numerous test trials on prepared solutions containing from one to 87.5 mg. Cr_2O_3 and from one to 47 mg. V_2O_5 showed errors, with two exceptions, of much less than $\frac{1}{2}$ mg. and establish the method as trustworthy in competent hands.

A further table showed the applicability of the method to ores and rocks to which known amounts of Cr_2O_3 and V_2O_5 had been added. These were fused together with sodium carbonate and nitrate; the silica and alumina were removed from the alkaline extract; phosphorus, chromium and vanadium were thrown down by $\text{Hg}(\text{NO}_3)_2$; the mixed precipitate was ignited; the residue refused with a little sodium carbonate, and in the resulting aqueous extract both chromium and vanadium were estimated, the results being equally as good as those obtained with simple solutions.

The author suggested that the reaction of H_2O_2 on Cr_2O_3 and V_2O_5 in the presence of ether might be utilized to remove the greater part of the chromium prior to titration of the vanadium, since the oxidation product of chromic acid dissolves in the ether, while that of vanadic acid does not; also that the brown color produced in vanadic solutions by H_2O_2 might be made the basis of an exact colorimetric method for the estimation of vanadium.

The next paper was presented by Dr. de Schweinitz and Mr. Marion Dorset and was entitled 'The Mineral Constituents of the Tubercle Bacilli.' The authors, in continuation of their work upon the study of the tubercle bacilli, made a careful analysis of the ash and found a very large percentage of phosphates, calcium, magnesium, potassium and sodium. They pointed out the apparent close connection between the high content of fat and phosphates in the body of the germ and the method of treating tuberculous patients with codliver oil and phosphates. The work is being continued now in the direction of a careful study of the albuminoids of the germ.

Mr. Fireman presented a paper on 'Some Observations on the Centric Benzene Formula and the Aromatic Character.' The centric formula is ascribed to the unreduced ring, while to the partially reduced ring a structure with the double bonds in the ordinary sense is at-

tributed. The transformation of the unreduced into the reduced ring and *vice versa*, as well as the transformation of the ring with the centric structure into the ring with the double bonds and *vice versa*, must be recognized as a characteristic feature of benzene and its derivatives, the aromatic compounds. If this is so, then the centric formula is inapplicable to a ring of either 5, 7 or any odd number of carbon atoms, reduction of such rings being impossible, since the valencies could not be satisfied in case of reduction. Hence the rings of 5 and 7 carbon atoms nearest to benzene in the number of members of the nucleus can not be expected to be endowed with an aromatic character. On the other hand, assuming, as we must, that the tension in the benzene ring, due to the closing of the latter, is small, then a ring of 4 or 8 carbon atoms would similarly have too much tension, which would be incompatible with such a degree of stability as we find in aromatic compounds. It follows, therefore, that from the standpoint of the centric formula and of ring-tension only the benzene ring can be expected to be a carrier of the aromatic character, which is in entire agreement with the facts.

The last paper of the evening was presented by Dr. Stokes, and was entitled 'The Meta-phosphimic Acids.' The paper outlined an attempt to explain some of the properties of the meta-phosphimic acids by means of von Baeyer's tension theory. These acids have the general formula $(\text{PNO}_2\text{H}_2)_n$ and may be regarded as ring compounds. Regarding the rings as polygons, the acids actually studied are as follows, the angle between adjacent sides of the polygon and its difference from 135° , the angle involving the least tension being given:

	Angle between sides.	Difference from 135° .
$\text{P}_3\text{N}_3\text{O}_6\text{H}_6$	120°	-15°
$\text{P}_4\text{N}_4\text{O}_8\text{H}_8$	135°	0°
$\text{P}_5\text{N}_5\text{O}_{10}\text{H}_{10}$	144°	$+9^\circ$
$\text{P}_6\text{N}_6\text{O}_{12}\text{H}_{12}$	150°	$+15^\circ$
$\text{P}_7\text{N}_7\text{O}_{14}\text{H}_{14} = (\text{P}_7\text{N}_7\text{O}_{14}\text{H}_{14} + \text{H}_2\text{O})$	154.3°	$+19.3^\circ$

Of these acids $\text{P}_4\text{N}_4\text{O}_8\text{H}_8$ is vastly more stable than the preceding member and represents a maximum stability with a presumable minimum of tension. $\text{P}_5\text{N}_5\text{O}_{10}\text{H}_{10}$ is less stable than $\text{P}_4\text{N}_4\text{O}_8\text{H}_8$ but more stable than $\text{P}_3\text{N}_3\text{O}_6\text{H}_6$, while

the tension in the ring of $P_7N_7O_4H_{14}$ is too great to permit of its existence and it spontaneously takes up water, forming $P_7N_7O_{12}H_{18}$. A further confirmation is found in the fact that the higher members on decomposition in part close again to form the stable ring-acid $P_4N_4O_6H_8$, indicating a disposition to form rings containing P_4N_4 . An attempt to test this theory further will be made by endeavoring to prepare diphosphonitric chloride, $P_2N_2Cl_4$. The corresponding meta-phosphimic acid, $P_3N_3O_4H_6$, should have the angle 90° , differing from the angle of least tension, 135° , by 45° . Such an acid should be much less stable than even $P_7N_7O_4H_{14}$, and should pass at once into $P_2N_2O_3H_4$.

WILLIAM H. KRUG,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MAY 17.

MR. C. S. BOYER illustrated the structure and geographical distribution of diatoms by a large series of lantern views preparatory to describing the following new species: *Rhabdonema Woolmanianum*, *Biddulphia semicircularis Asburyana*, *B. argus*, *B. interrupta*, *B. keeleyi*, *B. Shulzei* and *B. verrucosa*. The paper, with figures, will be published in the *Proceedings* of the Academy.

MR. T. C. PALMER described and illustrated some of the phenomena of conjugation in *Closterium*. The essential steps are essentially as in *Spirogyra*, in that in both cases the process is at first a putting out of tubes which meet and fuse. But just as *Closterium* differs from *Spirogyra* in its method of cell-division, so it presents peculiarities in manner of formation of the zygospore. The two lobes of the desmid seem to possess a certain degree of individuality, at least at the period of conjugation. These lobes, owing to the peculiar method of growth of the plant, generally differ, at the time of conjugation, in age, and therefore in size, and in the thickness, color and markings of the cell-walls. The contrast between two ends or lobes of a given cell is often very great; and in *C. acerosum*, as a rule, each desmid first separates into two entirely distinct and independent semi-cells, each of which is beautifully rounded off at its blunt end by a new growth of cell-wall. The young semi-cell of each desmid then conjugates

with the old semi-cell of the other, and two perfectly distinct zygospores are thus formed. These zygospores and the empty semi-cell cases are held together by a nearly or quite invisible jelly. The 'individuality of the semi-cell,' a tendency toward which has been remarked upon heretofore by Mr. Archer in the case of *C. lineatum*, here becomes practically complete.

In one instance *C. acerosum* formed three zygospores instead of two. One of these was the usual size, made up of the commingled contents of an old and new semi-cell. The other two were about half the size, and consisted each of the unmixed contents of another semi-cell. Of a similar nature is the recently observed discharge, without conjugation, of the contents of a whole cell in *C. lineatum*. The protoplasm, containing small round or ovoid bodies like those in the ordinary zygospore, issued from the ruptured union of the semi-cell cases. It assumed a spherical form. Its development could not be followed further.

The development of the zygospores of *Closterium* is not thoroughly well understood, but the phenomena are probably similar to those of the germination of *Cosmarium*. In addition, however, to this process, another method of reproduction is suspected in *Closterium*, of which the discharge of the cell-contents without conjugation may be one of the stages.

Many of the phases of reproduction in the desmids may be observed to advantage by placing zygospores in life-slides and following the changes that ensue. In such slides large numbers of very minute *Closterium* frequently appear, and these grow perceptibly from day to day, but it is not certain, or even probable, that these arise from the ordinary zygospore.

The following papers were presented for publication in the *Proceedings*:

'Descriptions of five new Phyllostome Bats,' by Gerrit S. Miller, Jr.

'Chitons collected by Dr. Harold Heath at Pacific Grove, near Monterey, Cal.,' by H. A. Pilsbry.

EDWARD J. NOLAN,
Recording Secretary.

Erratum: In the review of Wilder's System of Nomenclature, p. 716, col. 1, line 5, for 'chippocamp' read 'hippocamp.'

